Hydrogen Risk Assessment and Management for Hydrogen Economy

Rita Liang*, Gardner Lee, Sammy Chin, Tony Clouthier, Joshua Murphy

***Technical lead**: zhe.liang@cnl.ca, 1-613-584-3311 ext. 44484

1. Objectives and Primary Stakeholder

- Support the development of new energy-related technologies and develop hydrogen hazard assessment tools and mitigation measures to ensure safety for hydrogen production, storage, delivery and dispensing.
- NRCan (important for hydrogen economy and use of hydrogen for transport).

2. Hydrogen Hazard Assessment Approaches and Tools

- Performed a literature review to gather the state-of-art knowledge on quantitative risk assessment (QRA) methodologies and engineering correlations.
- Establishing theory manual for an engineering toolkit developed by the Université du Québec à Trois-Rivières (UQTR); collaboration with UQTR for further development.
- Evaluated engineering correlations of H2 jets to determine maximum extent (ME) of flammable mixture

3. Passive Hydrogen Ventilation System

- Venting is the most effective measure to prevent hydrogen explosions, but expensive in extreme climates.
- Developed a passive ventilation concept to mitigate hydrogen risks in case of leaks from an indoor hydrogen storage system (e.g., hydrogen vehicles in a garage);
- Patent application for the conceptual design is in progress.

4. Hydrogen Accumulation in Semi-Confined Space

- Hydrogen accumulation in confined spaces (e.g., fuelling station or garage) is a safety concern for the use of hydrogen as an energy carrier.
- Experiments in a polycarbonate enclosure, visualized with Background Oriented Schlieren (BOS) technique (Fig. 2) to examine the effect of ventilation on hydrogen mitigation.
- Liang et al. [1] showed that the helium (a simulant of H2) was nearly well mixed in the volume without an opening in the upper region (Fig. 3). Tests with vents on side walls to examine the effect of natural/forced venting are planned.

5. Achievements, Expected Outcome and Future Work

- Journal publications on experimental studies and patent submission for passive ventilation strategy for mitigation of hydrogen risk for indoor storage.

- Validated engineering toolkit to assist with the design and assessment of hydrogen installations.
- Training material for safe production, storage, transport and use of hydrogen.
- Considering memberships to connect with broader hydrogen community